Toxic Cyanobacterial Blooms in Copco and Iron Gate Reservoirs and the Klamth River, 2005-2008

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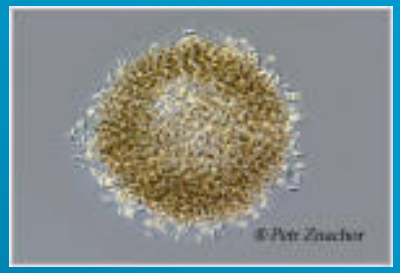
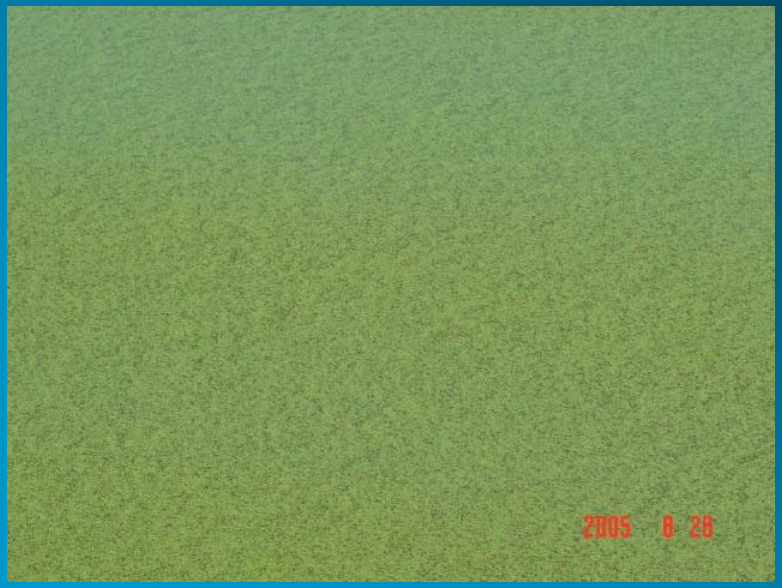
11/20/2008

Microcystis aeruginosa:

- Blue green algae
- Appearance
  - Flakes
  - Colonies
  - “Oil slick”



- Prefers slow or still, warm, nutrient rich water
- Concentrations change with wind conditions
- Regulates buoyancy



Microcystin:

- Liver toxin
- Releases toxin when cells die and break open
- Three orders of magnitude higher than the average pesticide
- Steep dose-response curve
  (little acute damage may occur until levels close to severe acute toxicity are reached)
- May act as tumor promoters

Possible Exposure Pathways:

- Contaminated drinking water
- Recreational activities such as wading, swimming, water skiing, and canoeing
- Consuming fish and shellfish from contaminated waters
  - -Oregon DHS recommends removal of organs during moderate blooms and no consumption guidelines during blooms over 1 million cells/ml
  - -CA OEHHA is currently working on guidance

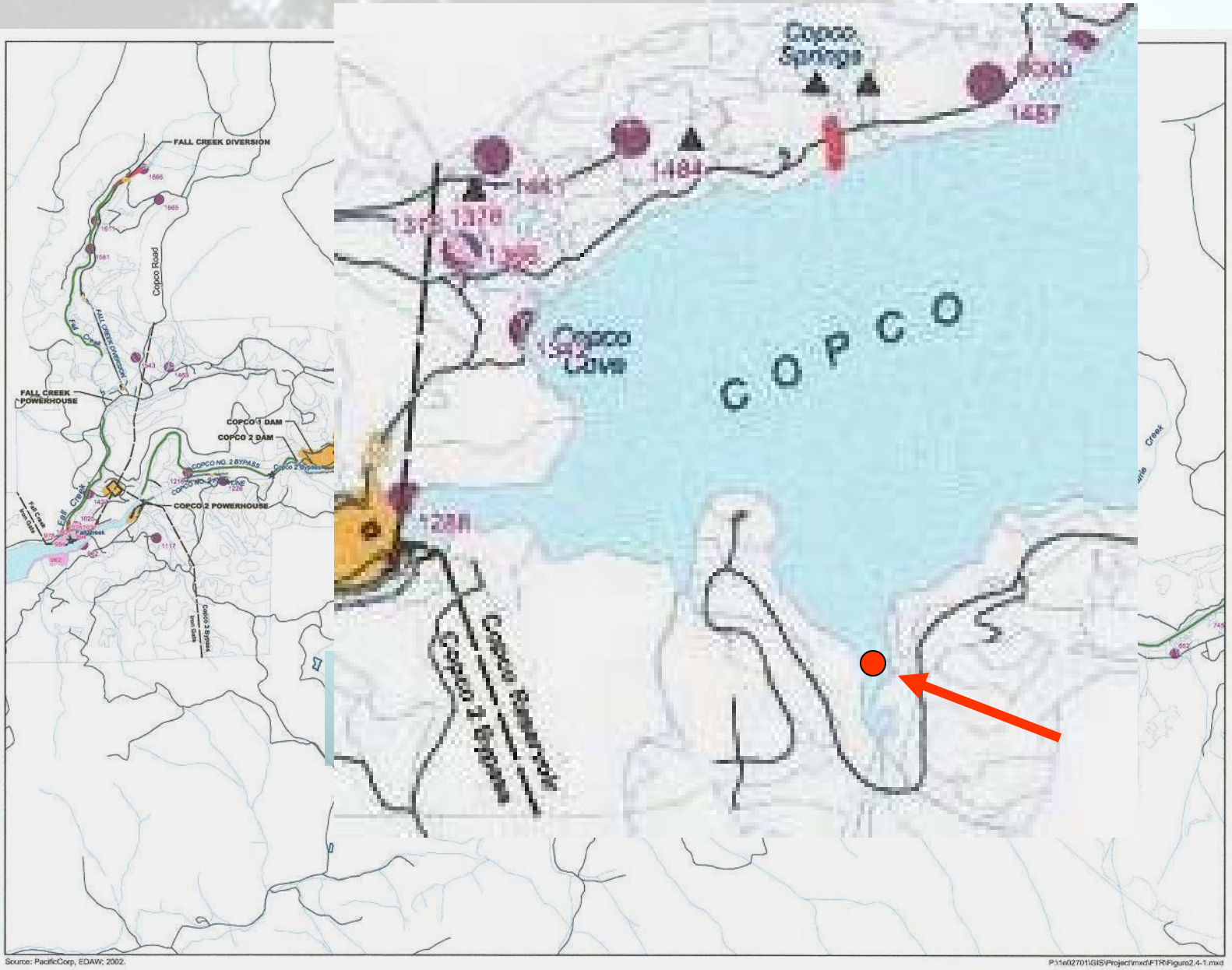
Children and toxins:

More susceptible to toxins for a variety of reasons, including smaller body size, potential for more incidental ingestion and response to symptoms.

Microcystin in Tissue:

- Can bioaccumulate in shellfish and fish.
  - -Shrimp and snail tissue.
  - -Blood, bile, intestines, liver, kidneys, and tissue in fish in lake in China.
  - -Liver of salmon, striped bass, and tilapia.
  - -Tissue and liver of rainbow trout in Australia.
  - -Klamath data-next talk

- Physiological effects
  - -Linked to deaths of reared Atlantic Salmon in British Columbia and Washington state - Net pen liver disease
  - -Acute liver failure in salmon, striped bass, and shrimp
  - -Possible link b/w microcystin and cardiomyopathy in sea otters
  - -UC Davis working w/ Delta spp. (splittail)
  - -Livestock deaths in Canada attributed to microcystin 2007


FALL CREEK DIVERSION
Copco Road
FALL CREEK POWERHOUSE
COPCO 1 DAM
COPCO 2 DAM
COPCO NO. 2 BYPASS
COPCO 2 POWERHOUSE
Fall Creek
East Fall Creek
Copco Springs
Copco Cove
COPCO
Copco Reservoir
Copco 2 Bypass
Legend
Survey Types
Pond-Breeding Survey
Terrestrial Survey
General Wildlife Vegetation Plots
Project Facility Survey
BLM Amphibian/Reptile Survey
Fisheries Electro-shock Survey
In-Stream
Potential Foothill Yellow Legged Frog Sites
Spring
Open Water
Vegetation Polygon
Segment Boundary
Road
Project Facility
Stream
0
2000 Feet
1:35,000
Context
Klamath River Hydroelectric Projects
Amphibian and Reptile Survey Effort (3 of 8)
Source: PacificCorp, EOAW; 2002.
P:\1e02701\GIS\Project\mxd\FTR\Figure2.4-1.mxd

Toxins Found in Copco Reservoir Sample 2004

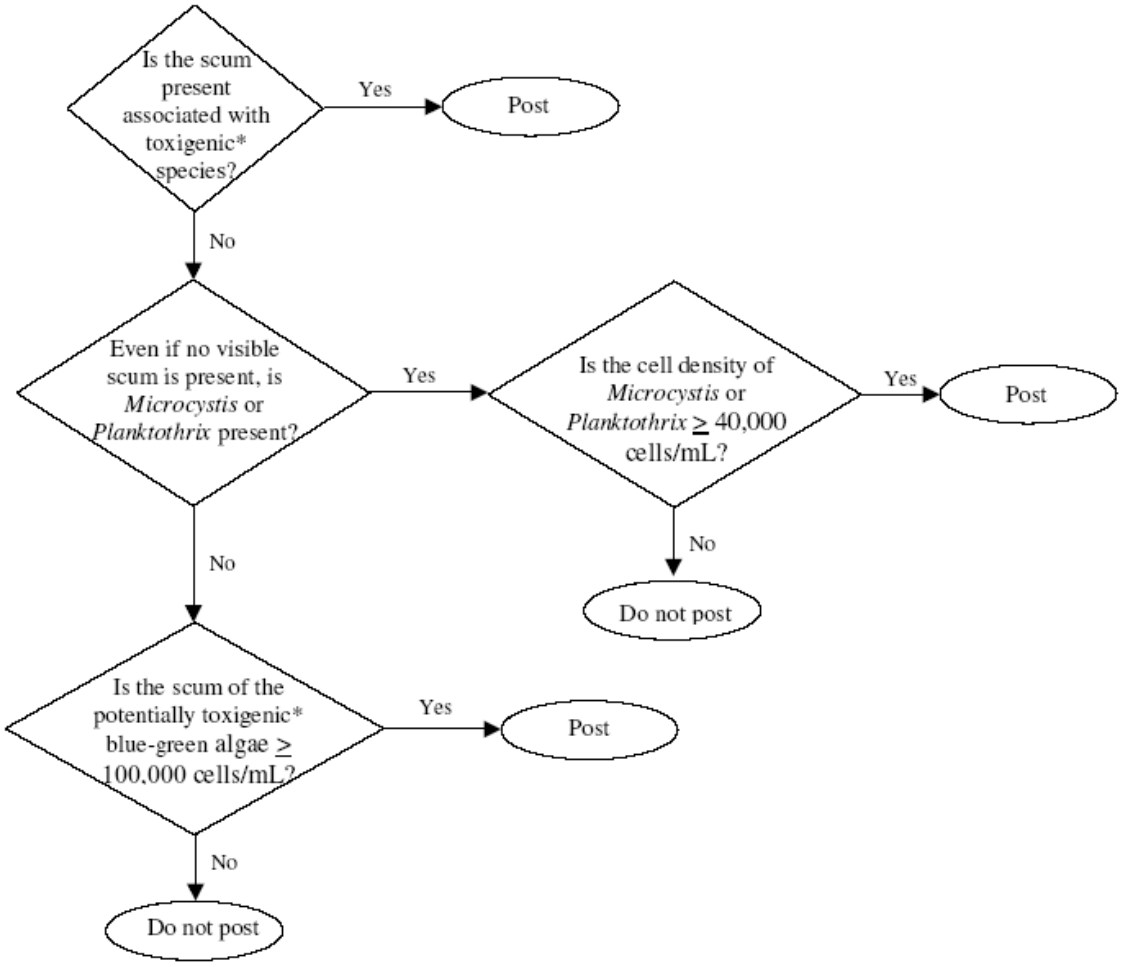
Microcystis aeruginosa:
1,908,732 cells/ml

Microcystin toxin level:
482 micrograms/L

From: Blue Green Algae Work Group of the State Water Resources Control Board and Office of Environmental Health and Hazard Assessment: *Cyanobacteria in California Recreational Water Bodies Providing Voluntary Guidance about Harmful Algal Blooms, Their Monitoring, and Public Notification (DRAFT June 2007)*

Posting Decisions:

- If visible scum is present: Post warning signs and distribute informational brochures.
- When sampling with microbial identification is available, the following decision chart is recommended:



*Potentially toxic blue-green algae that have been detected in California include those of the genera *Anabaena, Microcystis, Aphanizomenon, and Gloeotrichia.* Additional blue-green algae that are known to be potentially toxic may be added to this list.

http://www.waterboards.ca.gov/bluegreenalgae/index.html

2005-2008 Sampling

Biweekly Sampling for cell counts and toxin

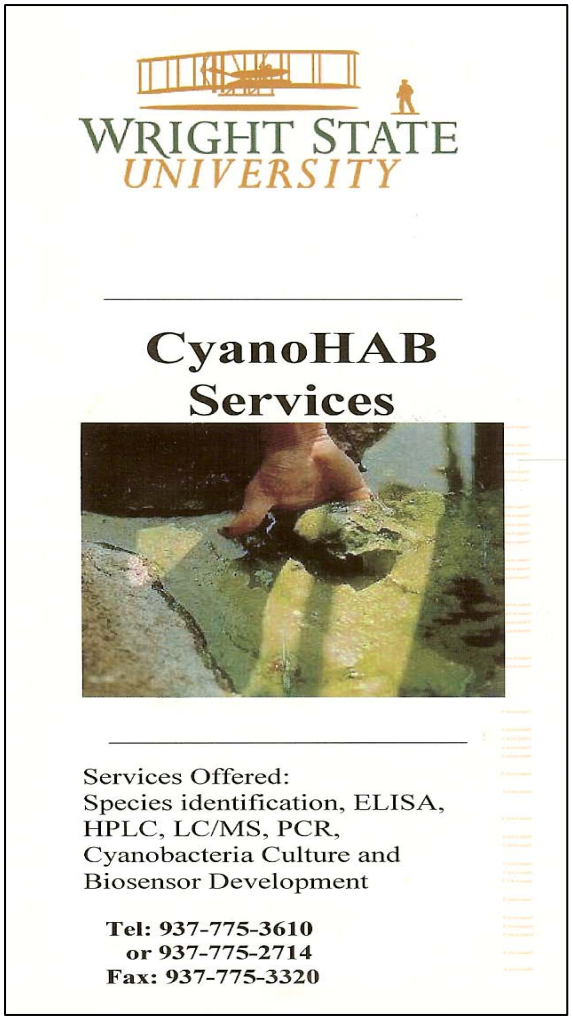
Working collaboratively w/ Yurok Tribe- covers lower Klamath

Grab samples of surface algal material.

Sample mid-channel River w/ long-term nutrient monitoring.

Cell counts: Samples preserved in Lugol's Iodine and Microscopic Analysis performed by Jim Sweet, Aquatic Analysts, White Salmon Washington

Microcystin Toxin Analysis: samples shipped on ice (over-night) air to Dr. Wayne Carmichael at WSU or EPA Region 9 Lab in Richmond for ELISA test for microcystin concentration.




Copco/ Iron Gate Reservoir Area
OREGON
CALIFORNIA
SV
OR
OREGON
CALIFORNIA
CRCC
CR01
CRMC
KRAC
IRCC
IRJW
IR01
KRBI
Iron Gate Reservoir
Copco
Copco Lake
Klamath River
Cold Creek
Bullhead Creek
Indian Creek
Negro Creek
Mill Creek
Edge Creek
Beaver Creek
Jenny Creek
Ditch Creek
Fall Creek
Salt Creek
Bogus Creek
Iron Creek
River Sample Stations
Reservoir Sample Stations
GPS Map Detail


Iron Gate 2005
11 12:38PM


2005 8 26


2005 9 20

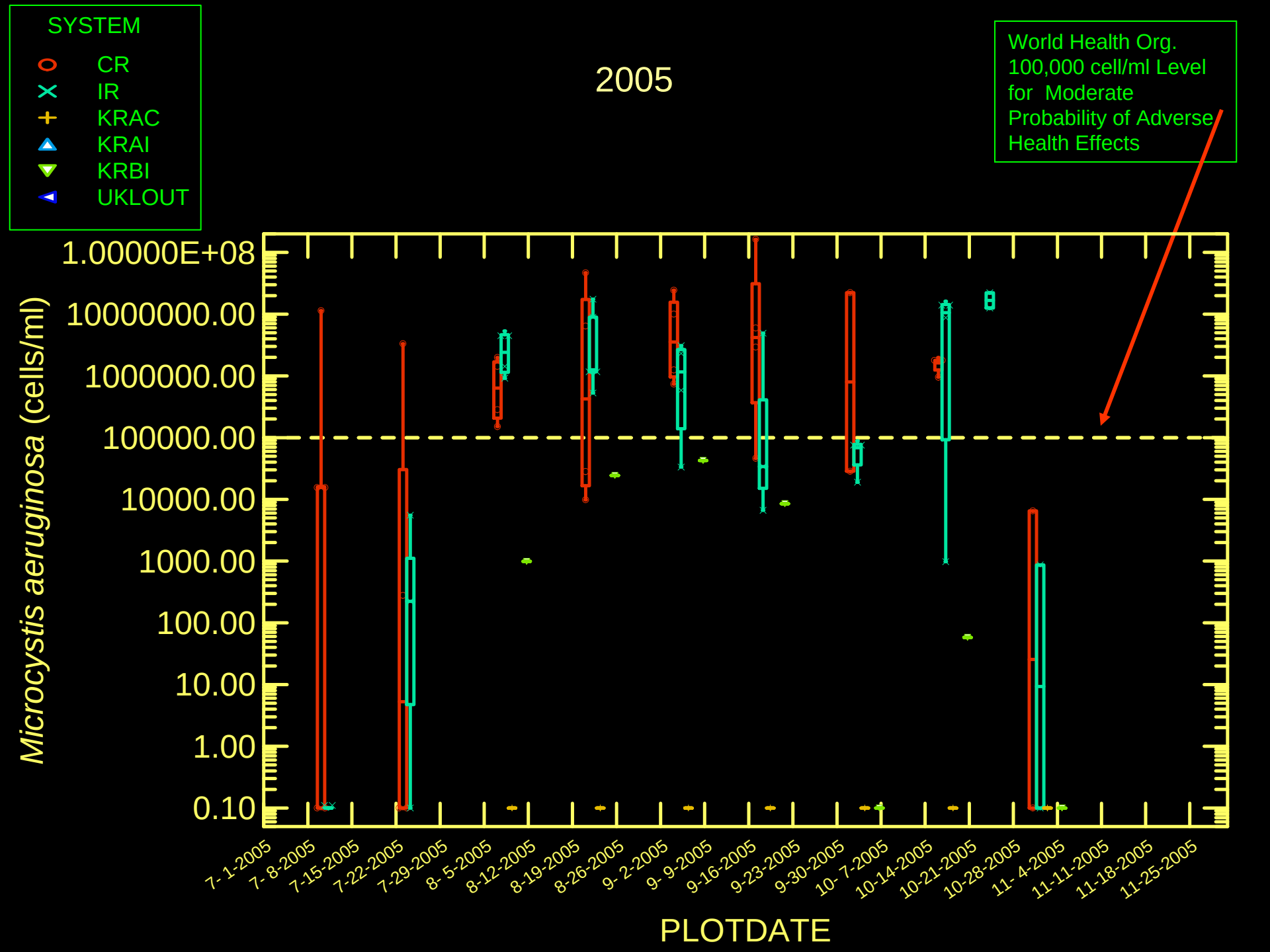

2005 8 26


Copco 2005
2005 9 20


2005 9 20


2005 9 7


2005 9 20


SYSTEM
CR
IR
KRAC
KRAI
KRBI
UKLOUT
2005
World Health Org.
100,000 cell/ml Level
for Moderate
Probability of Adverse
Health Effects
1.00000E+08
10000000.00
1000000.00
100000.00
10000.00
1000.00
100.00
10.00
1.00
0.10
Microcystis aeruginosa (cells/ml)
7-1-2005
7-8-2005
7-15-2005
7-22-2005
7-29-2005
8-5-2005
8-12-2005
8-19-2005
8-26-2005
9-2-2005
9-9-2005
9-16-2005
9-23-2005
9-30-2005
10-7-2005
10-14-2005
10-21-2005
10-28-2005
11-4-2005
11-11-2005
11-18-2005
11-25-2005
PLOTDATE


Iron Gate 2006


AUG 23 2006

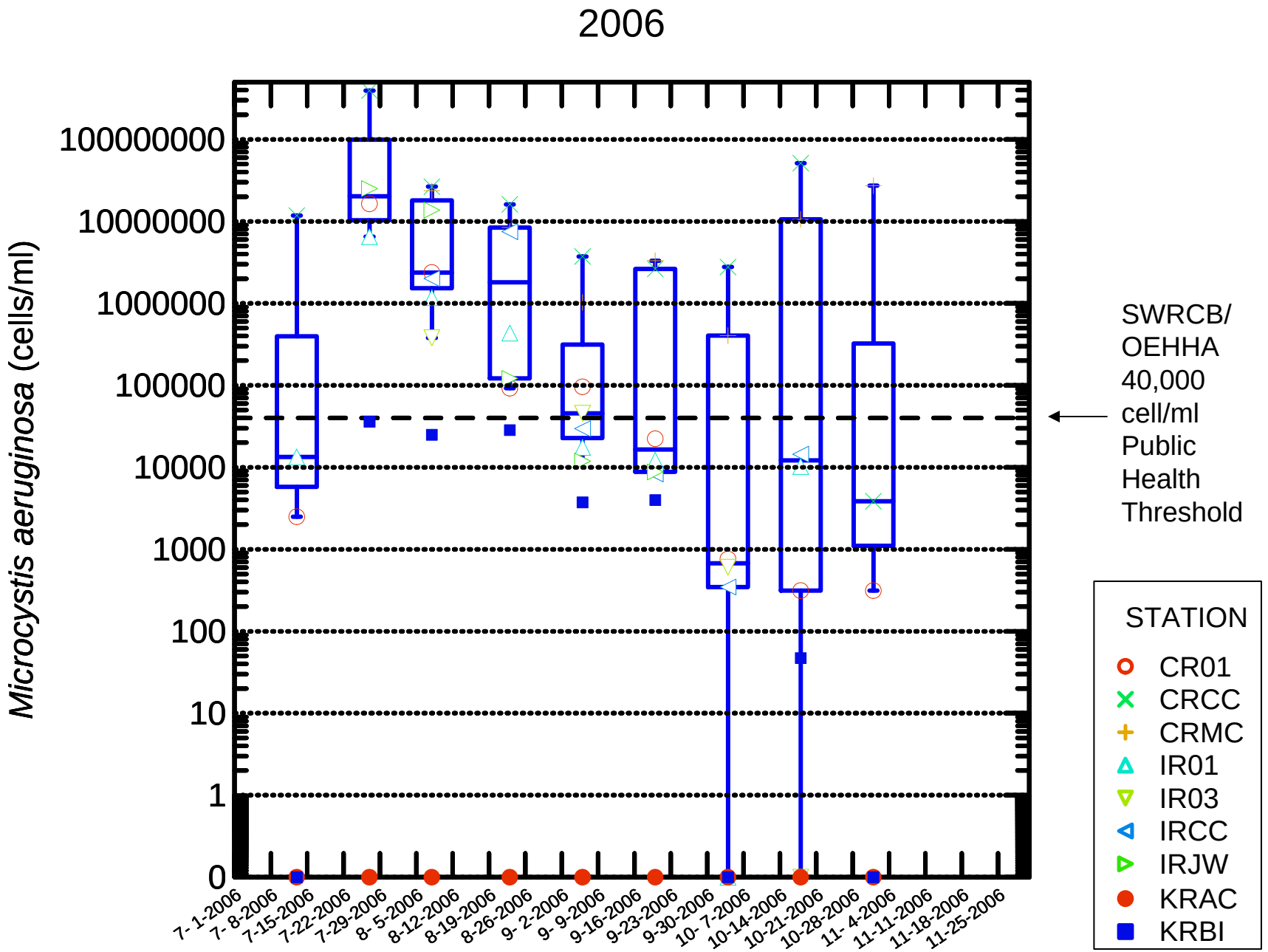

JUL 27 2006


Copco 2006
N


AUG 8 2006


JUL 27 2006


AUG 7 2006


2006
Microcystis aeruginosa (cells/ml)
100000000
10000000
1000000
100000
10000
1000
100
10
1
0
7-1-2006
7-8-2006
7-15-2006
7-22-2006
7-29-2006
8-5-2006
8-12-2006
8-19-2006
8-26-2006
9-2-2006
9-9-2006
9-16-2006
9-23-2006
9-30-2006
10-7-2006
10-14-2006
10-21-2006
10-28-2006
11-4-2006
11-11-2006
11-18-2006
11-25-2006
SWRCB/
OEHHA
40,000
cell/ml
Public
Health
Threshold
STATION
CR01
CRCC
CRMC
IR01
IR03
IRCC
IRJW
KRAC
KRBI

Iron Gate 2007

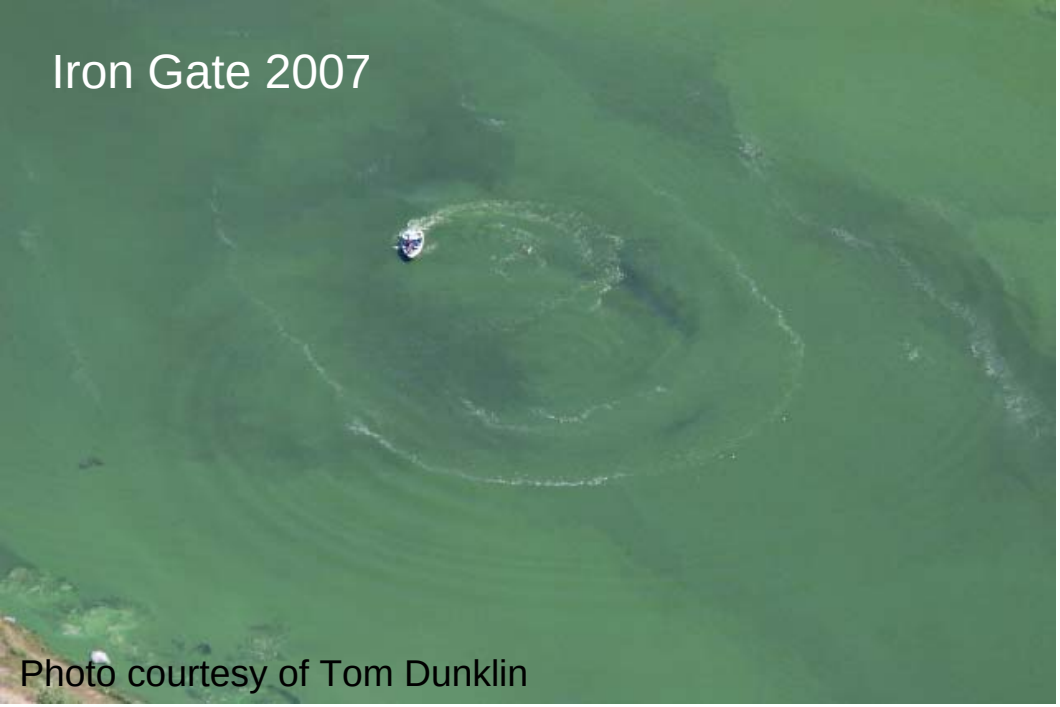
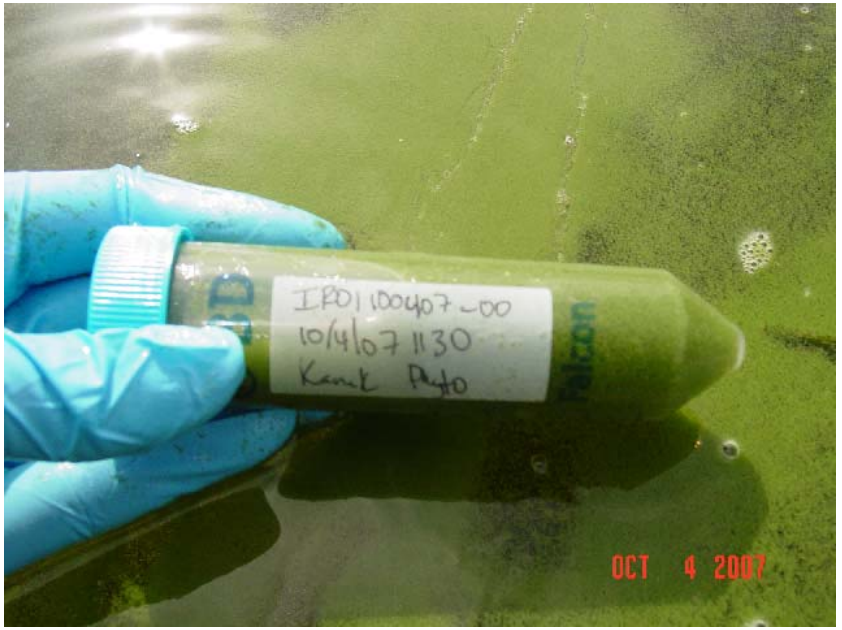


Photo courtesy of Tom Dunklin




Copco 2007

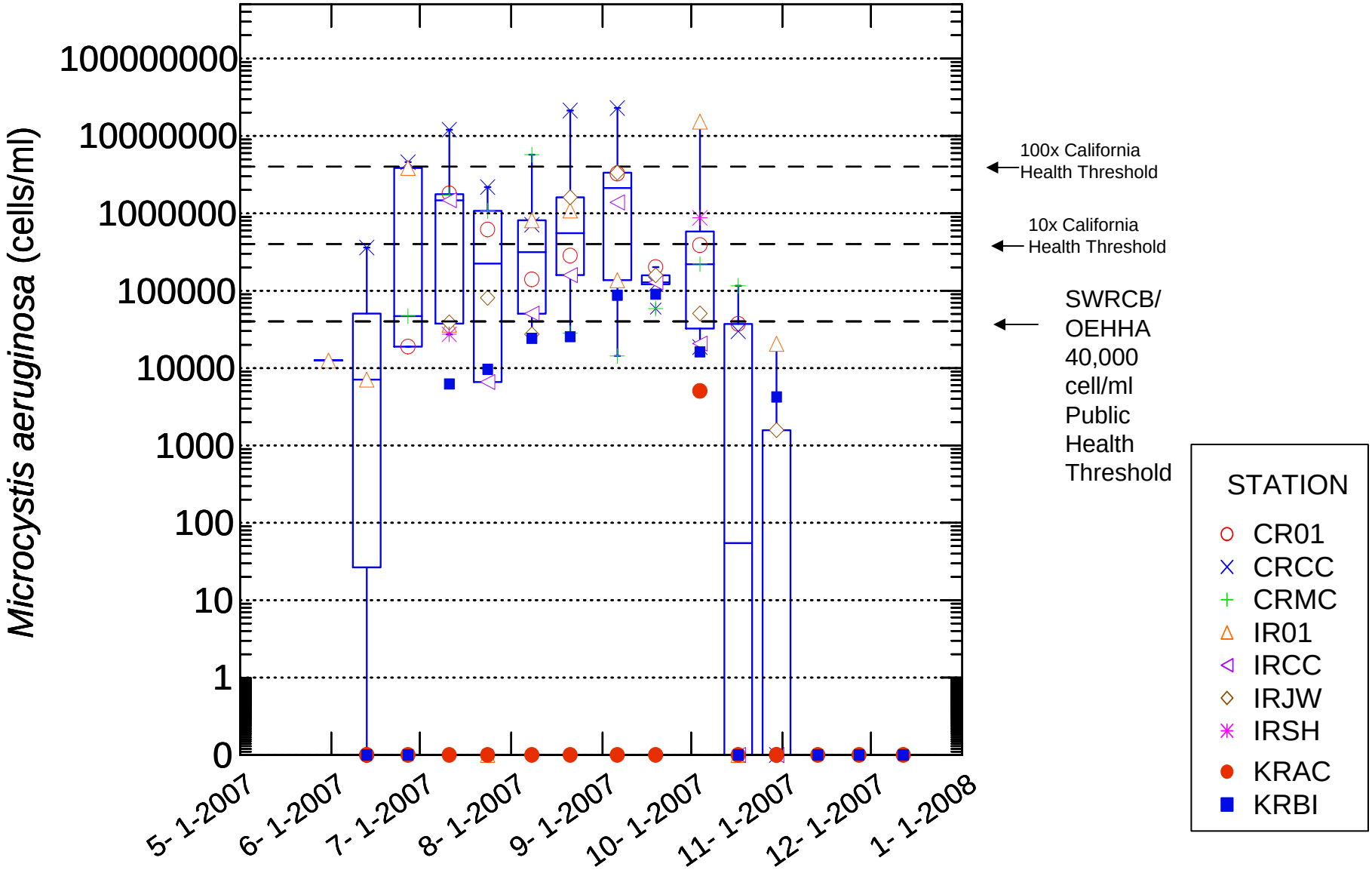
Klamath River above Beaver Creek 9/26/07

Klamath River below Iron Gate Dam

9/18/07

Klamath River below Iron Gate Dam

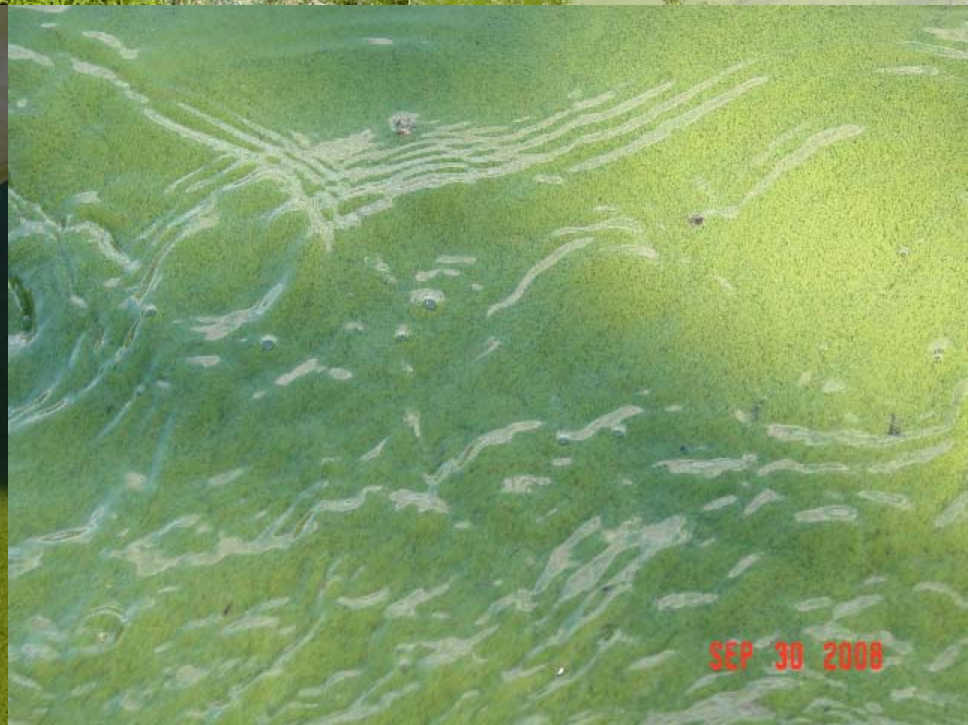
9/26/07

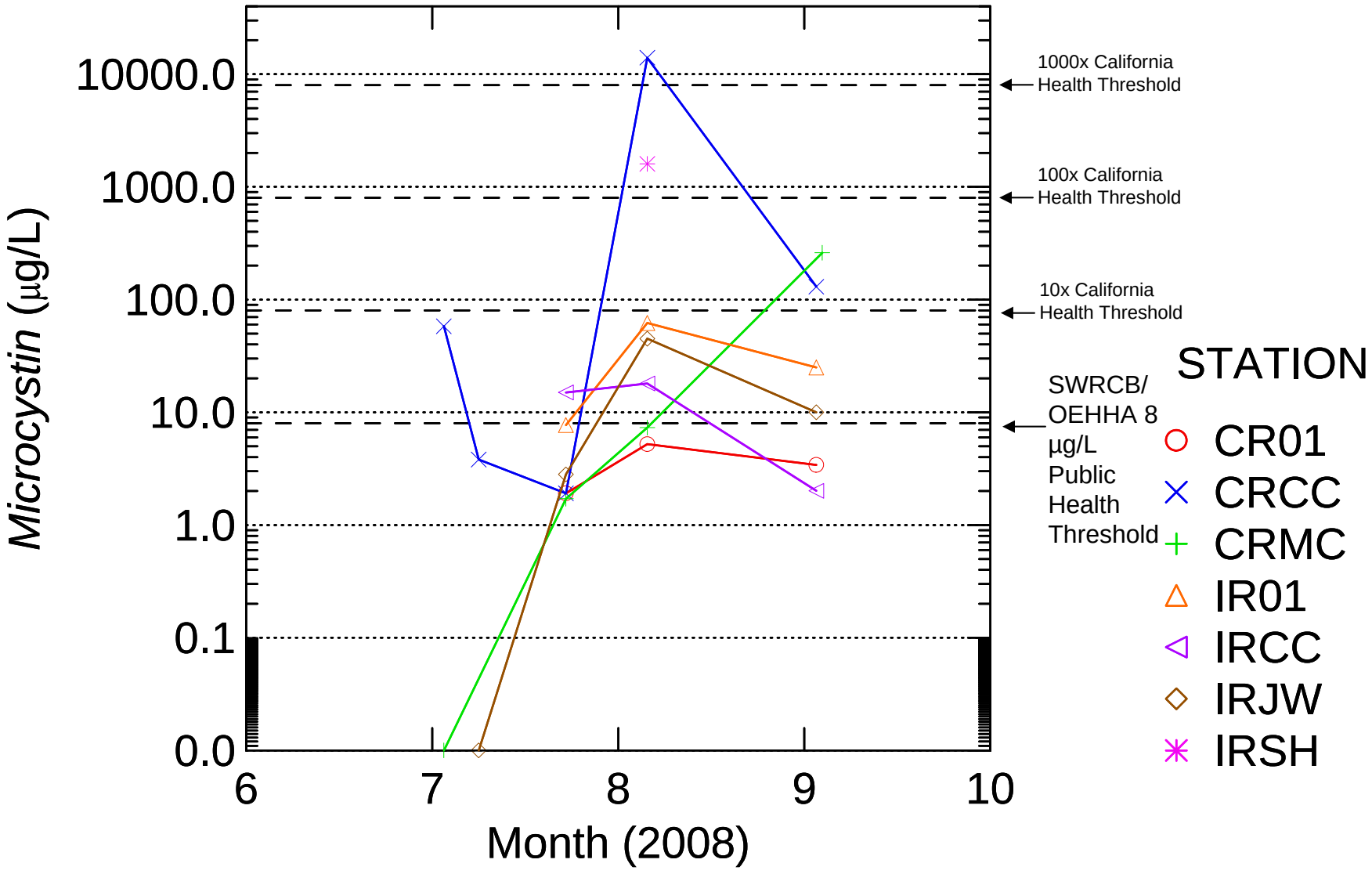


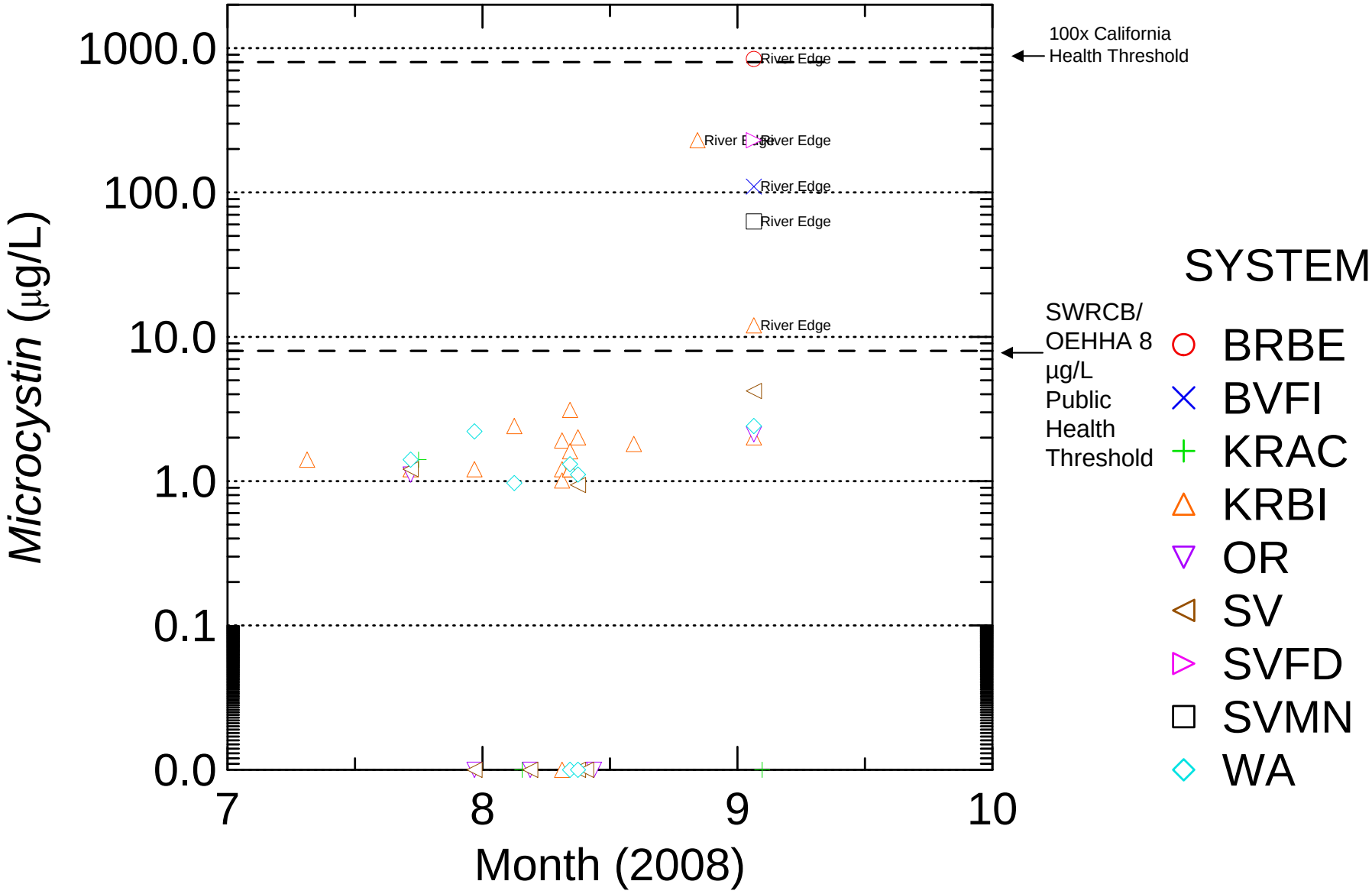
Microcystis aeruginosa cell density in Copco and Irongate Reservoirs, July-October, 2007. Note y-axis is log scaled and for graphing purposes all values have 0.1 added to them; Reservoirs=Copco and Iron Gate, KRAC=Klamath R. above Copco Reservoir, KRBI=Klamath R. below Iron Gate Reservoir.

Iron Gate 2008

Copco 2008




10000.0
1000.0
100.0
10.0
1.0
0.1
0.0
Microcystin (µg/L)
6
7
8
9
10
Month (2008)
1000x California Health Threshold
100x California Health Threshold
10x California Health Threshold
SWRCB/ OEHHA 8 µg/L Public Health Threshold
STATION
CR01
CRCC
CRMC
IR01
IRCC
IRJW
IRSH


1000.0
100.0
10.0
1.0
0.1
0.0
7
8
9
10
Month (2008)
Microcystin (µg/L)
100x California Health Threshold
SWRCB/ OEHHA 8 µg/L Public Health Threshold
River Edge
River Edge
River Edge
River Edge
River Edge
SYSTEM
BRBE
BVFI
KRAC
KRBI
OR
SV
SVFD
SVMN
WA

Next Steps:

- 2008 data back by January
- 2008 Toxic Algae Report out this spring
- Secure funding for additional tissue sampling
- Additional shoreline Klamath River samples in 2009

Questions?

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